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BIBLIOGRAPHY OF RESEARCH ON HEAVY HYDROGEN COMPOUNDS

This volume is a collection of references—about 2000 in number—to published literature on the subject of the heavy hydrogen isotope. The material is classified according to subject in such a manner that previous work in the field may be readily found. The volume should prove useful to anyone concerned with research on isotopes and their application to specific problems.

From the volume preface:

“A bibliography of such research should be welcomed by any worker involved with isotopes. To those familiar with the field it will serve as a reminder of what has been done and suggest new experiments that should be done. To the beginner in isotope research, whether it be with stable or radioactive nuclear species, no better survey of past accomplishments can be supplied. The ingenuity, industry, and achievements of the thousands of investigators, representing every country where scientific research is pursued, have made this bibliography possible. The many unsolved problems that might be studied by isotopic methods can be pursued only if we have a secure knowledge of the attainments of the past.”

George M. Murphy
New York University
Division Editor
Special Separations Project

NATIONAL NUCLEAR ENERGY SERIES
Manhattan Project Technical Section

Division III—Volume 4 C

BIBLIOGRAPHY OF RESEARCH ON
HEAVY HYDROGEN COMPOUNDS

BIBLIOGRAPHY OF RESEARCH ON HEAVY HYDROGEN COMPOUNDS

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**BIBLIOGRAPHY OF RESEARCH ON
HEAVY HYDROGEN COMPOUNDS**

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FOREWORD

The United States program of development of atomic energy has been described by Major General L. R. Groves, who, as Commanding General of the War Department's Manhattan Project, directed the program from mid-1942 until December 31, 1946, as "a generation of scientific development compressed into three years." The tremendous scope of the Manhattan Project Technical Section of the National Nuclear Energy Series, which has been in preparation since 1944, is a tribute to the unprecedented accomplishments of science, industry, government, labor, and the Army and Navy working together as a team. These volumes can be a firm foundation for the United States atomic energy program which, in the words of the Atomic Energy Act of 1946, is " . . . directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace."

David E. Lilienthal, Chairman
U. S. Atomic Energy Commission

ACKNOWLEDGMENT

The Manhattan Project Technical Section of the National Nuclear Energy Series embodies results of work done in the nation's wartime atomic energy program by numerous contractors, including Columbia University. The arrangements for publication of the series volumes were effected by Columbia University, under a contract with the United States Atomic Energy Commission. The Commission, for itself and for the other contractors who contributed to this series, wishes to record here its appreciation of this service of Columbia University in support of the national nuclear energy program.

PREFACE

This volume is one of a series which has been prepared as a record of the research work done under the Manhattan Project and the Atomic Energy Commission. The name Manhattan Project was assigned by the Corps of Engineers, War Department, to the far-flung scientific and engineering activities which had as their objective the utilization of atomic energy for military purposes. In the attainment of this objective, there were many developments in scientific and technical fields which are of general interest. The National Nuclear Energy Series (Manhattan Project Technical Section) is a record of these scientific and technical contributions, as well as of the developments in these fields which are being sponsored by the Atomic Energy Commission.

The declassified portion of the National Nuclear Energy Series, when completed, is expected to consist of some 60 volumes. These will be grouped into eight divisions, as follows:

- Division I — Electromagnetic Separation Project
- Division II — Gaseous Diffusion Project
- Division III — Special Separations Project
- Division IV — Plutonium Project
- Division V — Los Alamos Project
- Division VI — University of Rochester Project
- Division VII — Materials Procurement Project
- Division VIII — Manhattan Project

Soon after the close of the war the Manhattan Project was able to give its attention to the preparation of a complete record of the research work accomplished under Project contracts. Writing programs were authorized at all laboratories, with the object of obtaining complete coverage of Project results. Each major installation was requested to designate one or more representatives to make up a committee, which was first called the Manhattan Project Editorial Advisory Board, and later, after the sponsorship of the Series was assumed by the Atomic Energy Commission, the Project Editorial Advisory Board. This group made plans to coordinate the writing programs at all the installations, and acted as an advisory group in all matters affecting the Project-wide writing program. Its last meeting was held on Feb. 9, 1948, when it recommended the publisher for the Series.

The names of the Board members and of the installations which they represented are given below.

Atomic Energy Commission Public and Technical Information Service	Alberto F. Thompson
Technical Information Branch, Oak Ridge Extension	Brewer F. Boardman
Office of New York Operations	Charles Slessor, J. H. Hayner, W. M. Hearon *
Brookhaven National Laboratory	Richard W. Dodson
Carbide & Carbon Chemicals Corporation (K-25)	R. B. Korsmeyer, W. L. Harwell, D. E. Hull, Ezra Staple
Carbide & Carbon Chemicals Corporation (Y-12) †	Russell Baldock
Clinton Laboratories ‡	J. R. Coe
General Electric Company, Hanford	T. W. Hauff
General Electric Company, Knolls Atomic Power Laboratory	John P. Howe
Kellex Corporation	John F. Hogerton, Jerome Simson, M. Benedict
Los Alamos	R. R. Davis, Ralph Carlisle Smith
National Bureau of Standards	C. J. Rodden
Plutonium Project Argonne National Laboratory	R. S. Mulliken, H. D. Young
Iowa State College	F. H. Spedding
Medical Group	R. E. Zirkle
SAM Laboratories §	G. M. Murphy
Stone & Webster Engineering Corporation	B. W. Whitehurst
University of California	R. K. Wakerling, A. Guthrie
University of Rochester	D. R. Charles, M. J. Wantman

* Represented Madison Square Area of the Manhattan District.

† The Y-12 plant at Oak Ridge was operated by Tennessee Eastman Corporation until May 4, 1947, at which time operations were taken over by Carbide & Carbon Chemicals Corporation.

‡ Clinton Laboratories was the former name of the Oak Ridge National Laboratory.

§ SAM (Substitute Alloy Materials) was the code name for the laboratories operated by Columbia University in New York under the direction of Dr. H. C. Urey, where much of the experimental work on isotope separation was done. On Feb. 1, 1945, the administration of these laboratories became the responsibility of Carbide & Carbon Chemicals Corporation. Research in progress there was transferred to the K-25 plant at Oak Ridge in June, 1946, and the New York laboratories were then closed.

Many difficulties were encountered in preparing a unified account of Atomic Energy Project work. For example, the Project Editorial Advisory Board was the first committee ever organized with representatives from every major installation of the Atomic Energy Project. Compartmentation for security was so rigorous during the war that it had been considered necessary to allow a certain amount of duplication of effort rather than to permit unrestricted circulation of research information between certain installations. As a result, the writing programs of different installations inevitably overlap markedly in many scientific fields. The Editorial Advisory Board has exerted itself to reduce duplication in so far as possible and to eliminate discrepancies in factual data included in the volumes of the NNES. In particular, unified Project-wide volumes have been prepared on Uranium Chemistry and on the Analysis of Project Materials. Nevertheless, the reader will find many instances of differences in results or conclusions on similar subject matter prepared by different authors. This has not seemed wholly undesirable for several reasons. First of all, such divergencies are not unnatural and stimulate investigation. Second, promptness of publication has seemed more important than the removal of all discrepancies. Finally, many Project scientists completed their contributions some time ago and have become engrossed in other activities so that their time has not been available for a detailed review of their work in relation to similar work done at other installations.

The completion of the various individual volumes of the Series has also been beset with difficulties. Many of the key authors and editors have had important responsibilities in planning the future of atomic energy research. Under these circumstances, the completion of this technical series has been delayed longer than its editors wished. The volumes are being released in their present form in the interest of presenting the material as promptly as possible to those who can make use of it.

The Editorial Advisory Board

COLUMBIA UNIVERSITY PROJECT FOREWORD

Government-supported research on nuclear energy first occurred in early 1940 when certain funds made available by the Army, Navy, and National Bureau of Standards were used for experiments at Columbia University. The subsequent history of this project as it expanded in many other universities and industrial laboratories is told in detail in the Smyth Report. Two of the major programs began at Columbia University: the uranium-graphite pile reactor and the gaseous diffusion method of uranium 235 separation.

Lack of sufficient laboratory space at Columbia for the development of both programs led to the transfer in the spring of 1942 of the uranium-graphite reactor program to the University of Chicago. The program of separation of uranium 235 by gaseous diffusion, and various ancillary projects, developed rapidly until not only all available space in the Columbia University buildings was occupied but, in addition, an even greater amount of rented space.

The project for the separation of uranium isotopes by gaseous diffusion was first carried forward through various government contracts under the direction of Harold C. Urey, Professor of Chemistry, and John R. Dunning, Assistant Professor of Physics. In 1943 the work was unified under a single contract with the Manhattan Engineer District with Professor Urey as Director. An account of the research on the major assignment, the separation of the uranium isotopes, is to be found elsewhere in the National Nuclear Energy Series. The volumes that this preface introduces deal with the general mathematical theory of isotope separation, with some new experimental methods of separating isotopes, with spectroscopic properties of uranium compounds, and with the chemical and physical properties of heavy water and other deuterium compounds. Most of this work was done at Columbia, but parts of it were carried on at the National Bureau of Standards and at The Johns Hopkins University.

George B. Pegram
Chairman, Columbia University Division
of War Research, 1941-1945

VOLUME PREFACE

The heavy hydrogen isotope, deuterium, is the most generally useful tracer atom now known because of the ease with which it may be concentrated and analyzed in comparison with other isotopes. From the time of its discovery in 1931 it has been the subject of a very large number of papers dealing with its properties and those of its compounds, it has been used to test numerous theories where mass effects were suspected, and it has proved to be valuable as a tracer in chemical and biological reactions.

A bibliography of such research should be welcomed by any worker involved with isotopes. To those familiar with the field it will serve as a reminder of what has been done and suggest new experiments that should be done. To the beginner in isotope research, whether it be with stable or radioactive nuclear species, no better survey of past accomplishments can be supplied. The ingenuity, industry, and achievements of the thousands of investigators, representing every country where scientific research is pursued, have made this bibliography possible. The many unsolved problems that might be studied by isotopic methods can be pursued only if we have a secure knowledge of the attainments of the past.

George M. Murphy
Editor-in-Chief, Division III
National Nuclear Energy Series

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The Manhattan Project Technical Section of the National Nuclear Energy Series is intended to be a comprehensive account of the scientific and technical achievements of the United States program for the development of atomic energy. It is not intended to be a detailed documentary record of the making of any inventions that happen to be mentioned in it. Therefore, the dates used in the Series should be regarded as a general temporal frame of reference, rather than as establishing dates of conception of inventions, of their reduction to practice, or of occasions of first use. While a reasonable effort has been made to assign credit fairly in the NNES volumes, this may, in many cases, be given to a group identified by the name of its leader rather than to an individual who was an actual inventor.

INTRODUCTION

The following bibliography of research on heavy hydrogen and its compounds is arranged alphabetically according to the name of the senior author of each work. The papers by a given author or group of authors are arranged in chronological order in so far as ascertainable. Names that are spelled in more than one way are cross-indexed, as are also coauthors.

Every attempt has been made to obtain a complete record of papers on the subject, but work on nuclear reactions has not been included unless other data of interest are reported. Approximately 80 per cent of the listings were obtained from Chemical Abstracts (January 1932 through December 1945), and the Chemical Abstracts reference has been included in the bibliography wherever possible. Most of the remaining references were derived from a bibliography compiled by George M. Murphy directly from the published literature between 1932 and 1936. Review papers are so described.

In order to make the bibliography more generally useful for those interested in a particular type of isotopic research or a special deuterated compound, both a Subject Index and a Compound Index have been supplied. These two indexes when used together should present a comprehensive picture of the content of each paper.

It will be noted that each entry in the bibliography is identified by a letter-number symbol and one or more other code letters designating a particular topic in the subject index. The key to this index is as follows:

Ab	ABUNDANCE OF DEUTERIUM
AbG	Geological (Including Petroleum)
AbO	Organic
Ad	ADSORPTION AND SORPTION
AdG	Gases on Solids
AdL	Liquid on Solids

- An ANALYTICAL METHODS
AnDn Density Methods
AnEl Optical Rotation
AnMg Magneto optic Methods
AnMs Mass Spectrograph
AnRf Refractive Index
AnTh Thermal Conduction
- Bi BIOLOGICAL EFFECTS OF HEAVY WATER
BiB Botanical
BiC Biochemical
BiZ Zoological
- Cr CRYSTAL STRUCTURE
CrX X-ray Diffraction
- Ec ELECTROCHEMICAL PROPERTIES
EcC Conductivities and Mobilities
EcO Overvoltage
EcP Electrode Potentials
- Ed ELECTRON DIFFRACTION
- El ELECTROMAGNETIC AND OPTICAL PROPERTIES (EXCEPT SPECTRA)
ElCl Color Effects
ElD Dielectric Constants and Dipole Moments
ElGd Gas Discharges
ElMg Magnetic Susceptibility
ElMr Magnetic Rotatory Power
ElRf Refractive Index
ElRo Optical Rotatory Power
ElSc Light Scattering
- Eq CHEMICAL EQUILIBRIA
EqG Gaseous
EqH Heterogeneous
EqI Ionic
EqL Liquid and Solution
EqQ Qualitative (Observations)
- Ge GENERAL AND REVIEW

In	DEUTERIUM AS AN INDICATOR OR TRACER
InBi	Biological
InKi	Reaction Kinetics
InSt	Structure Determination
Ki	CHEMICAL KINETICS
KiB	Biochemical
KiG	Gaseous
KiH	Heterogeneous
KiI	Ionic
KiL	Liquid and Solution
KiP	Photochemical
KiR	Radiochemical
Me	MECHANICAL PROPERTIES
MeAc	Acoustic Properties
MeD	Density, Compressibility, and Thermal Expansion
MeDf	Diffusion
MeSt	Surface Tension
MeV	Viscosity
No	NOMENCLATURE
Nu	NUCLEAR PROPERTIES OF DEUTERIUM
NuM	Masses and Binding Energies
NuMg	Magnetic Moments
NuR	Reactions
NuS	Spins
NuSt	Statistics
Se	SEPARATION
SeAd	Adsorption and Description
SeCf	Centrifuging
SeCh	Chemical Reaction
SeCr	Crystallization
SeDf	Diffusion (Including Thermal)
SeDs	Distillation
SeEl	Electrolysis
SeEm	Electroendosmosis
SeMs	Mass Spectrometer

So SOLUBILITY

- SoG Gases in Solids
- SoH In H_2O , HDO , and D_2O
- SoO In Organic Solvents

Sp SPECTRA AND SPECTROSCOPIC CONSTANTS

- SpA Atomic (Line) of Hydrogen and Deuterium
- SpEl Molecular Electronic
- SpFl Fluorescence
- SpVi Vibrational (Including Raman)
- SpX X-ray

Sy SYNTHESIS AND PREPARATION OF COMPOUNDS

Th THERMODYNAMIC AND RELATED PROPERTIES

- ThD Diffusion and Heat Conduction
- ThF Thermodynamic Functions for Pure Substances and Reactions between Them (E , H , F , S , C_v , C_p , ΔE , ΔH , etc.)
- ThP Phase Equilibria (Melting Points, Boiling Points, Vapor Pressures, etc., Including Heats)
- ThSo Properties of Solutions (Heats of Dilution, Vapor Pressures of Solutions, Activities, Fugacities)

On consulting one of these topics in the Subject Index, each pertinent paper may then be found by the letter-number symbols there listed.

In preparing the Compound Index, the nomenclature used in Lange's "Handbook of Chemistry" was followed. Where this nomenclature resulted in an uncommon name for a familiar compound, both names have been given. For exchange reactions with water and the use of water as a solvent, no listing under Water has been made in the Compound Index. Such research may be found by consulting appropriate sections of the Subject Index. Other substances used as solvents are indicated by (s) following the reference number. Also omitted from the Compound Index are Hydrogen and Water where the subjects involved are: Abundance, Analytical Methods, Biological Effects (except Biochemical), General and Review, Nomenclature, Nuclear Properties, Separation, Atomic Spectra. In these cases, too, the Subject Index must be consulted.

Aid in compiling the bibliography was given by Max Metlay, Thomas Crowell, Herschel Markowitz, Samuel Millman, and Mary B. Allen. The difficult task of typing the manuscript was done by Ivy Bracking and Hortense Janofsky.

Section 1

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Section 2

SUBJECT INDEX

The following subject index has been arranged according to a series of principal topics indicated by two letters, for example, Chemical Kinetics, Ki. Subdivisions are given one or more additional letters, as Photochemical Kinetics, KiP. Under each topic, references are given to Section 1 of the Bibliography by letter-number combinations as S-100, meaning reference 100 under letter S. The letter, of course, indicates the name of the paper's senior author.

When a paper deals with more than one subject, this method of cross-indexing permits reference to be made to it under each appropriate subject heading.

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- Ad** **ADSORPTION AND SORPTION (Continued)**
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 P-66, R-50, R-51, R-59, R-60, R-61, R-62, S-6, S-72,
 T-11, T-63, W-32

- Bi** **BIOLOGICAL EFFECTS OF HEAVY WATER (Continued)**
- BiC** **Biochemical**
 B-28, B-32, B-114, B-116, B-163, B-170, B-180, B-208,
 B-210, B-211, C-3, C-4, C-5, F-82, F-92, F-93, F-98,
 G-48, H-158, J-2, J-3, J-4, M-8, M-9, M-131, P-36,
 P-37, P-38, P-39, P-40, P-41, R-40, T-49, W-97
- BiZ** **Zoological**
 A-46, A-48, B-20, B-21, B-22, B-23, B-24, B-25, B-26,
 B-27, B-29, B-30, B-31, B-33, B-34, B-35, B-45, B-46,
 B-47, B-50, B-51, B-52, B-53, B-55, B-56, B-57, B-58,
 B-160, B-161, B-162, B-171, B-209, B-212, B-251,
 B-252, C-63, D-15, D-48, D-58, D-62, E-62, F-83, F-91,
 F-94, G-5, G-48, G-75, H-3, H-38, H-39, H-42, H-90,
 H-91, H-101, H-102, H-105, K-99, L-52, L-95, M-10,
 N-5, P-5, P-52, P-62, R-26, R-113, S-29, S-30, S-68,
 S-102, S-145, S-163, T-42, U-31, W-81
- Cr** **CRYSTAL STRUCTURE**
 R-93, R-94, S-17, T-69, U-2
- CrX** **X-ray Diffraction**
 M-44, S-147, T-90, U-4, U-5, U-6, U-7, V-8, V-9, V-10,
 Z-9
- Ec** **ELECTROCHEMICAL PROPERTIES**
- EcC** **Conductivities and Mobilities**
 A-5, B-13, B-108, B-109, C-10, C-25, C-47, F-66, F-67,
 F-90, F-113, I-7, I-10, L-8, L-14, L-56, L-69, L-88,
 R-104, R-105, R-106, R-107, S-77, S-79, T-41, T-89,
 U-2, W-14
- EcO** **Overvoltage**
 B-194, C-6, C-8, H-110, H-111, H-112, H-113, H-114,
 H-126, H-141, H-144, N-33, V-1
- EcP** **Electrode Potentials**
 A-4, A-8, B-230, B-231, B-232, F-81, H-24, H-27,
 H-112, H-136, K-91, L-5, L-12, M-128, N-26, R-116,
 S-50, S-51, U-28
- Ed** **ELECTRON DIFFRACTION**
 K-16
- EI** **ELECTROMAGNETIC AND OPTICAL PROPERTIES (EX-
 CEPT SPECTRA)**
 A-48, B-225

**E1 ELECTROMAGNETIC AND OPTICAL PROPERTIES
(EXCEPT SPECTRA) (Continued)****E1C1 Color Effects**

B-94, B-248, D-54, F-59, K-1, K-15, K-88, K-89, M-32,
M-36, R-108, Z-3, Z-4

E1D Dielectric Constants and Dipole Moments

A-1, B-19, B-100, B-102, B-142, B-249, B-265, C-18,
C-19, D-36, D-37, G-71, H-2, H-129, H-130, I-15, I-49,
K-24, K-25, K-26, L-65, M-48, M-127, Q-1, T-1, T-50,
W-101, Z-19

E1Gd Gas Discharges

G-70, G-79, G-80, G-81, J-25, J-26, L-39, P-26, R-65,
S-138, T-103

E1Mg Magnetic Susceptibility

C-1, C-2, F-117, G-54, H-2, H-121, I-32, N-7, O-20,
R-5, R-6, S-59, S-79, S-120, T-81, T-82, W-79, W-80

E1Mr Magnetic Rotatory Power

D-59, D-60, F-57, G-2, H-6, O-19, S-89

E1Rf Refractive Index

B-87, B-88, B-201, B-222, C-13, C-26, C-133, C-134,
E-48, F-111, F-114, F-115, F-116, I-15, L-60, L-103,
M-13, M-39, M-111, O-19, O-32, O-33, R-30, R-92,
S-59, S-142, S-152, T-29, T-52, T-88, T-91, W-21, W-42

E1Ro Optical Rotatory Power

A-11, A-14, B-136, B-137, B-266, B-267, B-274, C-58,
C-59, C-61, C-62, C-106, D-61, E-26, E-31, E-42,
E-49, E-50, E-51, E-52, F-106, G-67, H-30, H-31, I-60,
J-13, L-40, L-41, M-7, O-8, O-20, P-2, P-4, R-43, Y-5,
Y-6

E1Sc Light Scattering

B-130, B-135, C-12, L-31, L-32, L-33

Eq CHEMICAL EQUILIBRIA

I-55, S-162

EqG Gaseous

A-8, A-48, B-225, B-271, B-272, C-67, C-102, C-122,
C-126, F-7, F-19, G-12, G-32, G-51, G-53, G-64, H-22,
H-120, I-29, J-24, J-32, J-48, M-57, M-136, P-12, R-55,
R-81, R-90, S-134, S-136, S-139, T-27, T-70, T-80, U-3,
U-28, W-65, W-66, W-67, W-68

EqH Heterogeneous

A-8, B-65, B-145, B-169, B-199, B-225, B-276, C-26,
C-27, C-30, C-31, C-117, C-119, C-120, C-121, C-122,

- Eq CHEMICAL EQUILIBRIA (Continued)
- EqH Heterogeneous (Continued)
- F-6, F-12, F-13, F-16, F-17, F-18, F-27, F-40, F-47,
 F-76, G-1, G-11, G-50, G-53, H-5, H-12, H-120, H-138,
 H-139, H-140, H-145, H-146, I-2, I-29, J-20, J-32, K-14,
 K-31, K-55, K-90, K-91, L-71, M-78, M-105, O-7, O-14,
 O-23, P-9, P-10, R-53, R-54, R-55, R-56, R-58, R-83,
 R-89, R-90, S-74, S-94, T-19, T-20, T-26, T-28, T-70,
 T-73, T-90, T-100, U-3, W-37, W-38
- EqI Ionic
- A-3, A-4, A-5, C-129, C-130, D-17, D-18, D-53, E-28,
 E-29, E-35, E-59, G-35, G-41, G-63, H-23, H-27, K-44,
 K-91, L-7, L-8, L-12, L-13, L-68, L-69, M-80, O-7,
 O-36, R-116, S-49, S-50, S-51, T-74, W-105
- EqL Liquid and Solution
- A-3, A-7, A-8, A-9, A-10, A-27, B-104, B-177, B-199,
 B-219, B-225, B-236, B-237, B-244, B-247, B-256,
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 E-57, E-63, E-77, F-16, F-50, F-79, G-8, G-9, G-26,
 G-67, H-12, H-14, H-15, H-17, H-28, H-29, H-44, H-49,
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 I-56, I-57, I-58, I-59, J-5, J-47, K-2, K-3, K-37, K-44,
 K-52, K-60, K-69, K-70, K-71, K-72, K-73, K-74, K-75,
 K-76, K-78, K-79, K-80, K-81, K-82, K-83, K-91, K-93,
 K-94, L-5, L-11, L-12, L-66, M-35, M-37, M-78, N-1,
 O-3, O-4, O-5, O-6, O-12, O-13, O-15, O-17, O-21,
 O-22, O-34, O-36, R-17, R-23, R-40, R-41, R-48, R-55,
 R-87, R-116, S-2, S-44, S-48, S-67, S-92, S-93, S-95,
 S-96, S-143, T-9, T-12, T-45, T-73, W-8, W-33, W-71,
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- EqQ Qualitative (Observations)
- A-1, B-99, B-164, B-169, B-174, B-179, C-63, E-53,
 F-34, G-74, H-14, H-18, H-22, H-26, H-44, H-49, H-51,
 H-138, L-50, L-80, M-5, M-99, M-129, M-130, M-132,
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- Ge GENERAL AND REVIEW
- A-46, A-47, A-53, A-63, B-16, B-83, B-168, B-187,
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 D-6, D-7, D-8, D-10, D-46, D-47, E-9, F-5, F-38, F-74,
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 H-11, H-56, H-63, H-65, H-163, I-9, J-18, J-33, K-9,
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- Ge** **GENERAL AND REVIEW (Continued)**
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- In** **DEUTERIUM AS AN INDICATOR OR TRACER**
B-225, R-110
- InBi** **Biological**
A-28, B-68, B-115, B-116, B-117, B-118, B-119, B-120, B-153, B-171, B-176, C-21, C-92, C-104, E-21, F-36, F-54, F-83, H-8, H-46, H-103, H-104, H-106, H-108, K-98, K-100, P-46, P-47, P-62, R-24, R-82, R-84, R-85, R-86, R-87, R-88, R-111, S-29, S-33, S-35, S-36, S-37, S-38, S-39, S-40, S-41, S-42, S-43, S-64, S-86, S-103, S-116, S-122, S-144, U-32, U-33, U-34, U-35, U-36, V-20, W-1, W-2, W-33
- InKi** **Reaction Kinetics**
A-34, B-18, B-86, B-171, B-175, B-181, E-30, E-56, F-23, F-29, F-36, F-82, F-102, G-67, H-127, H-136, H-138, H-146, H-147, H-152, H-153, I-16, I-19, I-56, I-58, I-59, I-60, J-7, J-12, J-32, J-42, J-47, K-49, M-55, M-63, M-105, M-116, N-10, O-21, O-22, R-40, R-44, R-102, S-34, S-43, S-133, S-134, S-135, T-9, T-16, T-25, T-59, T-101, T-102, V-18, W-7, W-53, W-102, W-104, Y-3, Z-18
- InSt** **Structure Determination**
E-30, E-54, E-55, E-64, E-65, G-42, G-43, G-44, I-17, L-25, M-55, O-25, S-95, S-132, T-8
- Ki** **CHEMICAL KINETICS**
P-56, R-102, S-162
- KiB** **Biochemical**
A-35, B-54, B-56, B-170, B-180, B-210, B-211, B-250, C-3, E-60, F-36, J-3, J-4, M-8, M-9, P-36, P-37, P-38, P-39, P-40, S-5, S-117, S-128, S-129, V-18
- KiG** **Gaseous**
A-22, B-1, B-84, B-98, B-146, B-169, B-173, B-273, C-82, D-4, D-12, E-79, E-80, F-7, F-8, F-19, F-20, F-31, F-32, F-33, F-39, F-41, F-43, F-48, F-120, G-7, G-12, G-46, G-64, H-116, H-118, H-121, J-32, J-42,

- Ki** CHEMICAL KINETICS (Continued)
- KiG** Gaseous (Continued)
K-18, K-41, L-48, L-86, M-51, M-52, M-57, M-84,
M-95, M-100, P-32, P-35, P-55, R-103, S-75, S-104,
S-130, S-131, S-136, S-139, S-157, T-80
- KiH** Heterogeneous
A-34, B-86, B-191, C-6, C-7, C-8, C-60, E-11, E-12,
E-13, E-58, E-76, F-4, F-9, F-11, F-21, F-22, F-24,
F-26, F-27, F-28, F-29, F-42, F-45, F-46, F-98, G-7,
G-10, G-11, G-12, G-24, G-58, H-117, H-118, H-119,
H-143, I-31, J-20, J-32, J-36, J-37, J-44, K-31, K-53,
K-55, K-56, M-53, M-63, M-83, M-101, M-102, M-103,
M-105, O-14, O-24, P-58, S-97, S-127, T-20, T-96, T-97,
T-98, T-100, T-101, T-102, U-8, U-27, W-40
- KiI** Ionic
B-172, O-16, O-34
- KiL** Liquid and Solution
A-2, A-6, A-29, A-30, A-32, B-165, B-169, B-178,
B-181, B-215, B-216, B-217, B-219, B-220, C-32, C-37,
C-90, F-30, F-102, F-103, G-4, G-6, G-65, G-66, G-67,
G-68, H-15, H-30, H-31, H-32, H-33, H-50, H-125,
H-148, H-150, H-151, H-156, I-16, I-56, I-57, I-60, J-5,
J-41, K-2, K-3, K-4, K-69, K-74, K-75, K-77, K-78,
K-79, K-80, K-82, K-83, L-10, L-81, L-83, L-98, M-33,
M-34, M-35, M-90, M-91, M-92, N-1, N-8, O-6, O-34,
O-36, P-2, P-3, P-4, R-40, R-41, R-42, R-43, R-44,
R-45, R-46, R-47, R-48, R-52, S-4, S-45, S-46, S-105,
S-126, S-168, T-68, W-8, W-9, W-58, W-73, W-102, Y-1
- KiP** Photochemical
C-89, C-103, C-108, C-127, C-132, F-37, H-89, J-43,
J-45, J-46, L-42, M-51, M-53, M-54, M-56, M-58, M-59,
M-97, M-98, M-104, P-65, P-66, S-100, S-134, S-136,
T-25
- KiR** Radiochemical
J-40, L-75, L-76, L-77, M-134
- Me** MECHANICAL PROPERTIES
A-46, A-48, B-140, B-195, B-223, B-225
- MeAc** Acoustic Properties
B-2, E-72, I-37, I-40, I-42, I-43, I-50, I-51, I-54, R-63,
Y-2
- MeD** Density, Compressibility, and Thermal Expansion
A-11, B-68, B-69, B-134, B-135, B-201, B-222, C-26,

- Me** **MECHANICAL PROPERTIES (Continued)**
MeD Density, Compressibility, and Thermal
 Expansion (Continued)
 C-32, C-34, C-35, C-48, C-56, C-66, C-81, C-105,
 C-134, E-48, F-52, H-126, H-130, H-151, I-6, I-15, I-16,
 I-59, J-19, J-28, J-43, K-3, K-60, K-105, L-62, L-78,
 L-87, L-94, L-103, M-13, M-45, M-46, M-68, M-75,
 M-111, M-117, P-29, R-30, R-48, R-95, R-104, R-115,
 S-23, S-24, S-25, S-32, S-59, S-107, S-108, S-120, S-142,
 S-156, S-170, S-171, T-2, T-12, T-24, T-29, T-55, T-69,
 T-87, T-88, T-89, T-90, T-91, U-1, W-21, W-37, W-74,
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- MeDf** Diffusion
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 F-101, G-76, G-77, G-81, H-61, H-70, I-41, J-29, J-30,
 J-31, J-37, J-38, J-39, L-84, M-38, M-61, M-115, O-35,
 O-37, R-101, S-164, S-168, T-40, W-82
- MeSt** Surface Tension
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- MeV** Viscosity
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 H-25, I-35, I-38, I-39, I-44, I-45, I-46, I-47, I-48, J-27,
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- No** **NOMENCLATURE**
 A-51, A-59, A-60, B-192, B-199, C-26, C-109, F-60,
 G-47, H-55, M-133, S-76, U-23, U-24, U-26, V-19, W-26,
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- Nu** **NUCLEAR PROPERTIES OF DEUTERIUM**
NuM Masses and Binding Energies
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 B-156, B-203, E-10, F-49, F-73, G-52, H-166, K-106,
 M-93, M-119, P-50, R-3, S-115, W-78
- NuMg** Magnetic Moments
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- NuR** Reactions
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- Nu** **NUCLEAR PROPERTIES OF DEUTERIUM (Continued)**
- NuS** Spins
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- NuSt** Statistics
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- Se** **SEPARATION**
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- SeAd** Adsorption and Desorption
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- SeCf** Centrifuging
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- SeCh** Chemical Reaction
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 H-160, J-20, P-13, P-14, P-18, P-23, R-57, R-64, S-113,
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- SeCr** Crystallization
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 F-126, G-51, G-59, G-60, H-58, H-69, H-70, H-77, H-93,
 H-94, J-29, J-31, K-92, K-95, L-24, L-84, M-3, M-6,
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- SeDs** Distillation
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 L-55, P-25, R-8, S-161, T-60, T-95, U-16, U-17, U-21,
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- SeEl** Electrolysis
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 B-255, B-276, C-16, C-24, C-26, C-45, C-100, E-8,
 E-32, E-38, E-39, E-71, E-82, E-83, F-10, F-88, F-110,
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- SoG Gases in Solids
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- SoO In Organic Solvents
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- Sp SPECTRA AND SPECTROSCOPIC CONSTANTS
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- SpA Atomic (Line) of Hydrogen and Deuterium
B-15, B-141, B-158, C-38, C-39, C-40, C-41, D-34,
D-51, D-52, G-21, G-22, G-23, H-7, H-59, H-107, H-154,
K-86, N-2, N-3, N-4, P-11, R-9, R-21, R-65, R-97, S-3,
S-63, S-121, S-146, T-76, U-19, W-47, W-48, W-49,
W-50, W-51, W-52
- SpEl Molecular Electronic
B-90, B-106, B-125, B-127, B-128, B-129, C-22, C-23,
C-52, C-111, C-112, C-113, C-114, C-115, C-116, D-24,
D-25, D-26, D-27, D-28, D-29, D-30, D-31, D-49, D-50,
D-56, D-57, E-22, F-2, F-3, F-77, F-78, F-84, F-85,
F-86, F-87, F-95, F-121, F-122, F-123, F-124, F-125,
G-13, G-14, G-15, G-16, G-17, G-18, G-19, G-20, G-61,
G-72, G-73, H-69, H-71, H-72, H-73, H-74, H-75, H-131,
H-132, H-164, H-165, I-3, I-4, I-5, I-18, I-21, I-22, I-23,
I-24, I-25, I-26, I-27, I-28, J-6, J-9, J-10, J-11, J-13,
J-15, J-21, J-22, J-35, J-43, K-32, K-84, K-85, K-101,
L-36, M-47, M-74, N-6, N-17, N-29, N-30, O-1, O-25,
O-26, O-40, P-33, P-34, P-68, P-69, P-70, P-71, R-19,
R-20, R-21, R-100, S-9, S-10, S-11, S-12, S-13, S-14,

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- SpEl Molecular Electronic (Continued)
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- SpFl Fluorescence
 C-135, I-17, S-125, W-57
- SpVi Vibrational (Including Raman)
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 C-13, C-15, C-29, C-42, C-43, C-51, C-93, C-99, C-101,
 C-102, C-110, C-125, D-1, D-2, D-14, D-16, D-19, D-21,
 E-1, E-4, E-5, E-15, E-16, E-17, E-18, E-22, E-23,
 E-24, E-66, E-70, E-78, F-40, F-50, F-51, F-53, F-80,
 F-127, G-3, G-18, G-29, G-30, G-31, G-32, G-33, G-39,
 G-40, G-41, G-42, G-43, G-44, G-45, G-82, H-16, H-54,
 H-78, H-79, H-80, H-81, H-82, H-83, H-84, H-85, H-86,
 H-87, H-88, H-95, H-96, H-97, H-98, H-99, H-124,
 H-128, H-131, H-133, H-134, H-155, H-162, I-11, K-22,
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 L-89, L-91, M-12, M-14, M-15, M-22, M-23, M-24,
 M-25, M-26, M-27, M-28, M-70, M-71, M-72, M-79,
 M-85, M-86, M-87, M-88, M-89, M-95, M-106, M-107,
 M-108, M-120, M-121, M-122, M-123, M-124, M-140,
 M-141, M-142, N-13, N-14, N-15, N-16, N-22, N-23,
 N-31, O-27, O-28, O-40, O-41, P-53, P-60, P-72, R-7,
 R-11, R-12, R-13, R-14, R-15, R-16, R-17, R-18, R-22,
 R-27, R-28, R-29, R-30, R-31, R-32, R-33, R-34, R-35,
 R-36, R-37, R-100, S-7, S-8, S-69, S-84, S-87, S-90,
 S-91, S-101, S-111, S-123, S-149, S-150, S-165, S-166,
 S-167, T-33, T-34, T-48, T-91, T-92, T-93, T-94, V-5,
 V-6, V-13, W-42, W-43, W-45, W-46, W-54, W-60, W-61,
 W-63, W-83, W-84, W-85, W-86, W-87, W-88, W-89,
 W-90, W-91, W-93, W-94, W-96, W-100
- SpX X-ray
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- Sy** **SYNTHESIS AND PREPARATION OF COMPOUNDS**
 A-14, A-27, A-44, A-48, B-17, B-19, B-102, B-116, B-122, B-126, B-154, B-155, B-183, B-184, B-186, B-195, B-197, B-199, B-200, B-201, B-222, B-223, B-259, B-265, B-274, C-32, C-43, C-55, C-57, C-58, C-60, C-63, C-92, D-1, D-19, E-18, E-24, E-25, E-27, E-31, E-41, E-44, E-45, E-46, E-47, E-48, E-49, E-50, E-56, E-58, E-59, E-61, F-30, F-47, F-50, F-52, F-78, F-80, F-98, F-112, F-114, G-35, H-2, H-4, H-5, H-13, H-37, H-79, H-80, H-81, H-83, H-88, H-89, H-96, H-109, H-118, H-126, H-127, H-137, I-15, I-16, I-60, J-36, J-45, K-37, K-43, K-46, K-49, K-58, K-59, K-60, K-63, K-104, L-27, L-37, L-38, L-40, L-41, L-76, M-13, M-15, M-33, M-79, M-88, M-89, M-95, M-103, M-105, M-111, N-14, N-18, N-22, N-23, N-28, O-12, P-31, R-29, R-32, R-34, R-35, R-36, R-37, R-41, R-45, R-88, R-90, R-91, R-94, S-4, S-33, S-36, S-45, S-87, S-107, S-108, S-109, S-113, S-114, S-137, S-139, S-142, S-150, T-45, T-88, T-91, T-93, T-94, U-5, U-6, U-27, U-34, U-36, W-31, W-33, W-35, W-42, W-54, W-55, W-59, W-63, Y-5, Z-1, Z-2
- Th** **THERMODYNAMIC AND RELATED PROPERTIES**
 B-140, B-225
- ThD** **Diffusion and Heat Conduction**
 A-23, A-56, A-57, B-166, B-167, B-233, F-105, K-11, K-12, K-50, L-17, M-67, N-32, S-28, S-113
- ThF** **Thermodynamic Functions for Pure Substances and for Reactions between Them (E, H, F, S, C_p , ΔE , ΔH , etc.)**
 B-19, B-66, B-74, B-75, B-84, B-85, B-101, B-110, B-138, B-143, B-146, B-159, B-218, C-66, C-67, C-68, C-70, C-71, C-72, C-73, C-75, C-76, C-77, C-78, C-88, C-91, C-95, C-98, D-38, E-29, E-70, F-56, F-71, F-96, G-24, G-32, G-35, H-15, H-17, H-123, I-49, I-51, I-54, J-24, J-48, K-15, K-44, K-47, K-48, K-91, L-7, L-15, L-45, L-85, L-90, M-35, M-58, M-69, M-90, M-92, M-118, M-136, N-18, N-19, N-26, O-36, R-56, R-112, R-116, S-26, S-54, S-114, S-157, T-46, T-69, T-80, U-21, U-28, V-3, W-36, W-37, W-103, Z-8
- ThPh** **Phase Equilibria (Melting Points, Boiling Points, Vapor Pressures, etc., Including Heats)**
 A-11, B-69, B-73, B-80, B-81, B-95, B-96, B-116, B-188, B-201, B-222, B-223, B-226, B-227, B-228,

- Th** **THERMODYNAMIC AND RELATED PROPERTIES**
 (Continued)
- ThPh** **Phase Equilibria (Melting Points, Boiling Points, Vapor Pressures, etc., Including Heats) (Continued)**
 B-229, B-233, B-253, B-254, B-265, C-10, C-25, C-26, C-33, C-53, C-64, C-65, C-66, C-69, C-70, C-73, C-74, C-77, C-86, C-87, C-88, C-91, C-97, C-98, D-13, D-22, D-38, E-3, E-18, E-27, E-29, E-35, E-36, E-44, E-47, E-48, E-70, E-73, E-74, F-1, F-96, F-97, F-104, F-109, G-34, G-69, H-13, H-21, H-109, H-115, H-124, I-15, J-1, J-43, K-46, K-60, K-87, K-102, K-103, K-104, K-105, L-6, K-9, L-18, L-23, L-41, L-47, L-55, L-57, L-58, L-59, L-62, L-64, L-66, L-67, L-72, L-85, M-4, M-13, M-49, M-75, M-76, M-77, M-78, M-111, M-126, N-20, N-21, P-8, P-43, R-14, R-38, R-69, R-70, R-74, R-75, R-93, R-98, R-112, S-21, S-22, S-26, S-27, S-53, S-54, S-55, S-99, S-106, S-107, S-108, S-109, S-113, S-114, S-127, S-137, S-140, S-142, S-152, S-153, S-154, S-155, T-5, T-6, T-7, T-15, T-24, T-29, T-51, T-54, T-55, T-58, T-73, T-90, T-91, U-17, W-3, W-21, W-42, W-55, W-56, Z-1, Z-8
- ThSo** **Properties of Solutions (Heats of Dilution, Vapor Pressures of Solutions, Activities, Fugacities)**
 B-104, B-142, B-143, B-144, B-220, B-232, C-32, C-44, D-38, D-39, L-18, L-19, L-20, L-21, L-22, L-23, L-73, M-48, R-98, R-99

Section 3

COMPOUND INDEX

The following compound index will be useful in finding references for research involving a given compound of deuterium. It is further subdivided by the same code letters used for the subject index. Reference to hexane, for example, will show that deuterated hexanes have been used in electromagnetic, equilibrium, and kinetic studies. The symbol (s) in the first case means that hexane was the solvent. The letter-number combinations, as in the subject index, refer to Section 1. Further details concerning this index will be found in the Introduction to the volume.

A few substances such as organisms, enzymes, glass, etc., which are not chemical compounds in the strict sense of the word, are included here for convenience.

Acenaphthene

EqL K-37

Acetal

EqL B-219

KiL B-216, B-219, H-151, O-36, R-43

Acetaldehyde

EqH H-138

EqL B-225, B-236, K-52

EqQ B-169, H-138

InKi A-34, H-138, M-116

KiL B-181, S-105

SpVi W-93

Sy Z-1, Z-2

ThPh Z-1

Acetamide

EqL B-236, B-237, R-48, S-92, S-93

KiL R-47, R-48

Acetanilide

EqL	S-96
EqQ	E-53
Sy	E-46, E-61

Acetate ion

EqQ	B-164
KiL	B-165

Acetic acid

BiC	B-114
EcC	L-68, L-69
EcO	H-126
Ed	K-16
Eq	I-55
EqI	G-35, H-27, K-91, L-7, L-8, L-68, L-69, S-49, S-51
EqL	B-219, B-225, C-47, D-3, K-2, L-66
EqQ	B-164
InBi	S-116
KiB	S-117
KiL	B-165, B-219, B-220, C-90, K-2
KiP	C-89
SpVi	A-43, A-44, E-23, E-24, H-85, H-86
Sy	A-44, B-199, E-24, E-61, H-13, W-55
ThF	G-35, L-7
ThPh	C-26, H-13, L-66, W-55
ThSo	B-220

Acetic acid, potassium salt of

EcC	C-47, L-8
EqL	B-199
EqQ	B-164, H-18
MeV	C-47

Acetic acid, sodium salt of

EcP	K-91
EqI	E-59
EqL	B-199, B-219, B-225, K-52
EqQ	B-169, L-80
KiL	B-165, B-219, B-220
ThSo	B-220

Acetomesitylene

EqL	B-257
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Acetone

EqH	H-138
EqL	B-177, B-199, B-225, B-236, B-237, B-247, F-16, H-12, H-14, H-15, I-19, K-52, S-48, W-71
EqQ	B-169, H-14, H-138
ElCl	K-88, K-89
InKi	A-34, H-138, R-44, S-133
KiH	F-26
KiL	H-15, R-43, R-44, R-45, R-52, W-9
KiP	H-89
SpEl	L-36
SpVi	B-79, E-23, E-24, G-40
Sy	R-45
ThD	L-17(s)
ThF	H-15
ThSo	C-32

Acetonitrile

EqL	R-48
KiL	R-47, R-48
SoH	P-59, T-56

Acetophenone

EqL	B-257
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Acetoxime

EqL	E-63
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Acetylacetone

EqL	B-225, K-52, N-1
SoH	N-1

Acetyl chloride

EqQ	E-53
SpVi	E-24
Sy	E-24

Acetyl choline

Sy	E-45
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Acetylene

AdG	K-56
EqG	G-12, G-32, H-120, R-55
EqH	G-11, H-120, R-53, R-54, R-55, R-56, R-58

Acetylene (Continued)

EqL	B-225
EqQ	B-99
KiG	G-12, J-42
KiH	C-60, F-28, G-11
KiP	J-45, M-53
KiR	L-75, L-76
SpEl	P-68, P-69
SpVi	B-196, B-197, C-99, G-30, G-31, G-32, H-95, H-96, H-97 M-12, M-106, M-107, M-108, N-13, R-7, S-150, S-165
Sy	B-197, E-27, H-96, J-36, J-45, K-58, L-76, S-150, W-59
ThF	C-66, G-32, R-56
ThPh	E-27

Acetylene dichloride

SpVi	T-92, T-93
Sy	T-93

Acetylene diiodide

Sy	E-27
ThPh	E-27

Aconitase

KiB	P-40
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Acrylic acid

EqL	B-236
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Adipic acid

BiC	B-116
InBi	B-116
Sy	B-116
ThPh	B-116

Adrenaline

BiZ	C-63
Sy	C-63

Alanine

EqL	S-143
KiB	P-38

Albumen

EqL B-225

EqQ B-169

Alcohols

KiL J-41

Alizarin

EqH K-90

Allylphenol

InKi K-49

Allyl xylol ether

InKi K-49

Sy K-49

Alum, potassium

Cr S-17

Alum, potassium chrome

Cr S-17

SpEl J-35

Aluminum

EqH J-20

KiH J-20

MeDf G-77

Aluminum carbide

EqH B-65, J-20

Aluminum chloride

EqH K-31

KiH K-31

Aluminum hydride

SpEl C-52, G-19, G-61, H-131, H-132, O-26

SpVl H-131, H-133

Amino acids

Sy U-34, U-36

Aminobenzoic acid

EqL B-236, B-237, S-92, S-93

Aminocaproic acid

KiB P-38

Aminofluorene

EqL B-257

Ammonia

CrX V-9
EcC L-69
EID B-265
ElRf F-114, F-115
ElSc L-32
EqG F-7, G-12, W-65, W-66, W-67
EqH B-199, G-11, H-12, T-26
EqI L-69
EqL B-225, T-12
EqQ B-174, L-50
InKi T-25
KiG B-273, E-80, F-7, F-8, G-7, G-12
KiH G-11, J-44, M-83
KIP C-127, F-37, J-43, M-54, M-56, T-25
KiR J-40
MeD J-43, T-24
SpEl B-106, D-56, D-57, J-43, T-24
SpVi B-40, B-42, B-43, B-70, E-78, G-33, H-155, M-25, M-26,
M-71, M-72, S-84, S-90, W-60
Sy A-48, B-265, F-114, K-43, K-46, W-31
ThF B-66
ThPh B-265, C-26, C-66, J-43, K-46, K-87, T-24

Ammonium bromide

ThPh C-86, S-106, S-109
Sy S-109

Ammonium chloride

CrX V-9
EqL A-27, B-236, O-3, O-5
MeD S-107, S-108
SpVi A-27

Ammonium chloride (Continued)

Sy A-27, N-18, S-107, S-108
ThF N-18
ThPh C-86, S-107, S-108

Ammonium ion

EqI S-49, S-51
EqL B-225

Ammonium nitrate

ThPh C-86

Ammonium phosphate, dihydrogen

CrX U-7

Ammonium salts

EqQ B-174

Ammonium sulfate

ThF N-19
ThPh C-86

Ammonium thiocyanate

ThPh C-86

Amyl alcohol

ElRo M-7
EqL H-124, I-19
SpVi H-124
ThPh H-124

Amylase

KiB C-3

Aniline

EqI S-49, S-51
EqL B-236, F-79, H-49, H-51, I-19
SpVi W-54
Sy B-122, W-54

Aniline hydrochloride

EqL H-52, K-72, K-73, K-74, O-21

Aniline hydrochloride (Continued)

InKi O-21

Kil K-74

Anisidine

EqH K-90,

Anisole

EqL I-13

Arginine

EqL S-143

InBi C-92

Argon

MeDf W-82

Arsenates

SpVi F-53

Arsenic acid

SpVi F-53

Arsine

SpVi D-16, H-80, L-38

Sy H-80, L-38

ThPh C-66, K-87

Ascorbic acid

EcC I-10

EqL I-10

Asparagine

EqL O-6

Aspartic acid

KiB P-37, P-39

Azomethane

KiG S-75

Barium chloride

EcC I-7

Barium chloride (Continued)

SoH A-48, E-3, L-18, T-18
ThPh E-3, B-96

Barium hydroxide

Sy M-33

Barium hypophosphite

EqI E-59
Sy E-59

Barium nitrate

EcC I-7

Benzaldehyde

EqL T-45
EqQ H-49, H-51
KiL F-102
Sy T-45

Benzaldehyde sodium hydrogen sulfite

EqL T-45
Sy T-45

Benzalmethoxybenzylamine

KiL S-4

Benzene

ElD I-15
ElMr D-59, F-57
ElRf B-201, E-48, I-15, M-111
ElRo E-52(s)
EqH H-139, H-145, H-146
EqL B-236, I-12, I-13, K-52, K-60, K-93, K-94, T-12, W-71
EqQ B-169, M-142
InKi H-146, H-147, H-152
InSt I-17
KiH C-60, E-12, F-22, F-45
Me B-195
MeD A-11, B-201, C-56, E-48, I-15, K-60, M-111
SpEl B-90, I-18, P-71, S-124, S-125
SpFl C-135, I-17, S-125, W-57
SpVi A-37, A-38, A-39, A-40, A-41, A-42, B-3, B-4, B-44, B-70,

Benzene (Continued)

- SpVi I-11, K-59, K-61, K-64, K-65, K-66, L-28, L-29, L-89,
L-91, M-142, R-28, R-33, R-34, R-35, R-37, S-123, W-90,
W-91
- Sy B-195, B-201, C-55, C-57, C-60, E-44, E-46, H-137, I-15,
K-59, K-60, L-27, M-111, R-34, R-35, R-37, W-35
- ThF L-90, Z-8
- ThPh A-11, B-201, E-44, E-48, G-69(s), I-15, K-60, M-111,
W-56, Z-8

Benzenesulfonic acid

- EqL I-13

Benzhydramine

- ElRo C-58, C-61
- Sy C-58

Benzhydramine hydrogen tartrate

- ElRo C-58
- Sy C-58

Benzhydramine oxalate

- ElRo C-58
- Sy C-58

Benzoic acid

- Cr R-94
- EcP R-116
- EqI E-29, R-116
- EqL B-236, H-49, H-51, I-19, K-2
- KiL K-2, K-4
- MeD R-95
- SoH E-29, E-47
- Sy E-46, E-47, E-48
- ThF E-29, R-116
- ThPh E-29, E-47, E-48

Benzoic acid, sodium salt of

- EcP R-116
- EqL B-199
- EqQ H-18

Benzophenone

- MeD A-11

Benzophenone (Continued)

Sy C-58

ThPh A-11

Benzophenone oxime

ThPh A-11

Benzoquinaldine

EqL K-37

Benzoyl peroxide

KlH E-58

Benzyl alcohol

EqL B-236, H-49, H-51, I-19, T-9

KlL F-102

Benzyl dimethylmethane

SpVi B-259

Sy B-259

Beryllium hydride

SpEl K-85

Beryllium hydride ion

SpEl C-52

Beryllium sulfate

SoH L-18

Biacetyl

EqL W-8

KlL W-8

Bicarbonate ion

EqI M-80

Bismuth

EqH G-53

Bismuth hydride

SpEl H-71, H-72

Bisulfate ion

EqI S-49

Boric acid

EqL O-5

Boron hydride

SpVi T-48

Bromate ion

EcC A-5

KiL A-6

Bromide ion

EqL A-7

KiL A-6

Bromine

EcC A-5

EqI A-5

EqL A-7

InKi R-44

KiG B-1, B-169, B-173, G-7

KiL R-41, R-43, R-45, R-52

SoH A-7

Bromodimethylaniline

EqL B-257

Bromoform

SpVi R-36

Sy R-36

Bromopalmitic acid

Sy H-109

ThPh H-109

Butane

EqG T-80

EqH F-12

KiG T-80

ThF T-80

Butene-1

KiH T-101

Butyl alcohol

KiH A-34

SoH T-57

Butylene

KiL F-30

Butyraldehyde

InKi A-34

Butyric acid

EqL I-58, I-59

SoH P-30, P-59, T-56

SpVi H-84

Sy S-33

Butyric acid, sodium salt of

Sy R-88

Cacodylic acid

EqI S-49

Cadmium hydride

SpVi D-14

Cadmium iodide

SoH E-3

Cadmium sulfate

SoH B-231

ThSo B-232

Calcium

EqH J-20

Calcium carbide

EqH J-20

Calcium hydride

SpEl G-19, G-72, G-73, O-26, W-27, W-28

Calcium hydroxide

EqL J-47, K-44

Calcium hydroxide (Continued)

Sy E-44

ThF K-44

Camphane

ElRo B-136, B-137, L-41

Sy L-41

ThPh L-41

Camphene hydrochloride

InKi N-10

Caproic acid, sodium salt of

Sy R-88

Carbohydrates

EqL H-44

EqQ H-44

Carbon

AdG K-56

KiH K-56

Carbon dioxide

EqH G-1

SoH C-128

Carbon disulfide

KiH F-45

Carbon hydride

SpEl F-2, F-3, G-13, G-14, G-17, G-18, G-19, G-20, S-70

SpVi G-18, W-100

Carbon hydrogen chloride

SpVi W-100

Carbonic acid

EqI C-129, C-130, M-80

Carbon monoxide

KiG M-51

Carbon tetrachloride

KiH F-45

SpVi E-16

ThPh F-1

Carboxylic acids

Eq I-55

Cellulose

AdL K-43

EqH C-30, C-31

EqL B-225

EqQ B-169

Cesium

SpA D-34

Cesium bromide

ThSo L-21

Cesium hydride

Sy H-4

ThPh B-188

Cesium phosphide

EqH B-65

Charcoal

AdG A-58, B-64, B-67, B-235, B-271, B-272, D-32, D-33, K-39,
K-40

EqH F-47

Chloral hydrate

Sy B-222

Chlorella

BiB C-108

KiP C-108, C-132, P-65

Chloride ion

EcC L-56

KiL A-6

Chlorine

EqG F-19
KiG F-39, G-7, R-103

Chloroacetate ion

KiL R-42

Chloroacetic acid

EcC L-69
EqI L-69, S-49
EqL B-236
EqQ M-132
Sy C-63

Chloroacetodihydroxybenzene

Sy C-63

Chlorodimethylaminonaphthalene

EqL B-258

Chloroform

ElRf B-222, T-91
EqL S-2
EqQ H-51
KiL H-148
MeD B-222, T-91
SpVi B-222, R-31, R-32, T-91, W-96
Sy B-222, R-32, T-91
ThPh B-222, T-91

Cholesterol

EqL R-87
Sy B-154, B-155

Cholesteryl chloride dibromide

EqL S-44

Choline

InBi S-86

Chromic chloride

EcC C-25
ThPh C-25

Chromic oxide

AdG B-91, B-93, K-68

Chromium complexes

ElCl D-54

Cobalt complexes

ElRo J-13

EqI E-35

EqL B-225, E-37, E-43, H-142, J-5, O-13, O-15

InKi B-18

KiL A-30, A-32, J-5

SpEl J-13

Cobaltous chloride

ElCl M-36

EqH P-9, P-10

ThPh B-95

Cobaltous sulfate

ElCl Z-3

ThPh B-96

Columbium

SoG S-181

Copper

AdG B-92, M-60, S-112

EcO H-141

EqH K-14

KiH H-119, J-36, W-40

MeDf G-76, G-77, M-61

Copper hydride

SpEl H-73, J-11

Coprostanone

InKi S-34, S-43

Coprosterol

InKi S-34, S-43

Crotonic acid

EqL I-58, I-59

Cupric chloride

ThPh B-96

Cupric complexes

EqL E-43

InKi B-18

Cupric oxide

AdG M-60

Cupric sulfate

CrX U-5

EcC I-7

ElCl B-94, B-248, Z-3, Z-4

EqH M-78

InKi M-63

KiH F-46, M-63

SoH L-18, M-76

Sy U-5

ThPh B-95, L-18, L-23, M-76, M-77, M-78, P-8, P-43, S-2
S-22

ThSo L-23

Cuprous chloride

EqH K-14, P-10

Cyclohexane

EqH F-27

EqL I-14, W-33

InKi H-152, H-153

KiH F-27

SpVi L-25

Cystine

EqL S-143

Diacetone alcohol

KiL B-216, H-151, N-8

Diacetyl

KiP H-89

Sy H-89

Dianisylphenylmethane

EqL K-37

Dibromobenzhydramine

ElRo C-62

Dibromoethane

SpVi H-83, M-88, M-108, M-142, R-28

Sy H-83, M-88

Dibromoethylene

SpVi T-94

Sy T-94

Dichloroethane

SpVi M-108

Didimethylaminonaphthalene

EqL B-258

Diethyl ketone

InKi A-34

Dihydroxybenzene

EqQ C-63, M-130

Dihydroxyxylene

EqQ M-130

Diisobutylene

KiL F-30

Dimethylamine

EqL G-36

Sy R-91

Dimethylaminofluorene

EqL B-257

Dimethylaminonaphthalene

EqL B-258

Dimethylaniline

EqL B-257, I-13, K-37

Dimethylglyoxime

EqH K-90

Dimethylindole

EqL K-70

Dimethylphenylmethane

ElRo B-274

Sy B-274

Dimethyl succinate

ElRf M-13

MeD M-13

Sy M-13

ThPh M-13

Dimethyl sulfone

KiL H-125

Dimethylsulfonic acid, sodium salt of

KiL H-125

Dinitrobenzene

ThPh C-26

Dioxane

ElD A-1(s)

EqL B-104(s)

EqQ A-1

KiL H-156(s), L-98

SpVi C-11(s), G-40(s)

ThF B-143

ThSo B-104(s), B-143, B-144(s), L-18(s), R-99(s)

Diphenyl

Sy E-58

Diphenylacetic acid

ElRo E-49

Sy E-49

Diphenylamine

EqL B-257

Diphenylaminomethane

ElRo A-11

ThPh A-11

Diphenyl ether

InKi K-49

Diphenylmethane

EqL K-37

Diphenylmethylethane

SpVi B-259

Sy B-259

Dithionic acid

KiL S-126

Dysprosium ethyl sulfate

ElCl R-108

EnzymesBiC F-82, F-92, F-93, F-98, H-158, J-3, J-4, M-8, M-9, P-36,
P-37, P-39, P-40, P-41

InBi F-88

KiB B-56, B-170, B-180, J-3, J-4, M-8, M-9

Ethane

AdG K-56

EqG S-136, T-80

EqH T-28

EqL T-57, T-12

EqQ F-34, M-99

InKi H-127, S-134

KiG M-95, M-100, S-131, S-136, T-80

KiH F-24, M-103

KiP S-134, S-136

MeD H-126

SpEl P-69

SpVi B-76, B-107, M-95, P-60, R-28, S-149, W-61

Sy H-125, H-127, M-95, M-103, M-105

ThF K-47, K-48, T-80

Ether

EqQ	H-49, H-51
KiG	D-12, M-84
SoO	E-35(s)
Sy	H-37
ThPh	E-36

Ethyl acetate

EqL	B-256, K-2
KiL	K-2, R-43

Ethyl acetoacetate

EqL	K-37
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Ethylacrylic acid

EqL	I-57
KiL	I-57

Ethyl alcohol

ElMr	D-59, F-57
EqH	H-138
EqL	B-236, B-256, B-257, B-258, J-47, K-2, K-37, O-34, R-40
EqQ	H-138
InKi	E-12, F-21, H-138, R-40
KiI	O-34
KiL	K-2, K-4, K-77, N-1, O-34, T-68
MeD	I-16
SpVi	B-189, H-16, M-85, M-86
Sy	C-32, E-56, I-16, K-37, S-4

Ethylamine

Sy	R-91
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Ethylamine hydrochloride

EqQ	R-91
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Ethyl benzoate

EqL	K-2
KiL	K-2

Ethyl bromide

SpVi	E-66, H-83, L-26
Sy	H-83

Ethyl butyrate

EqL B-256

Ethyl citraconate

EqL B-256

Ethyl crotonate

EqL B-256

Ethyl cyclohexylacetate

EqL B-256

Ethyl diazoacetate

KiL G-65, G-66, R-43

Ethyl dimethyl acrylate

EqL B-256

Ethyl diphenyl acetate

EqL B-256

Ethylene

AdG K-56

EqG C-102

EqH H-145, H-146, K-55, M-105

EqI D-17, D-18

EqQ F-34

InKi H-146

KiG G-7, J-42, M-51, M-95, P-35

KiH F-24, J-36, K-53, K-55, K-56, M-105, T-98, T-102, W-40

KiL F-30

KiP J-46

MeAc R-63

SpEl P-68, P-69, P-70

SpVi B-111, B-112, B-113, C-101, C-102, D-19, G-3, H-81,
H-82, L-43, M-22, M-23, M-24, R-28, S-167, T-33, V-13,
W-100

Sy D-19, H-81, J-36, M-105,

Ethylene dibromide

Sy W-59

Ethylene dichloride

SpVi W-100

Ethylene glycol

EqL B-199, B-225

EqQ H-18

Ethyl formate

KiL B-215, B-216, N-8

Ethyl iodide

KiG J-42

Ethyl laurate

EqL B-256

Ethyl malonate

EqL B-256

Ethyl mercaptan

EqL H-124, I-19

SpVi H-124

ThPh H-124

Ethyl mesaconate

EqL B-256

Ethyl methoxy phenyl acetate

EqL B-256

Ethyl methoxy propionate

EqL B-256

Ethyl methyl malonate

EqL B-256

Ethyl orthoformate

EqL B-219

KiL B-217, B-219, H-151, R-43

ThF B-218

Ethyl phenyl acetate

EqL B-256

Ethyl phenyl ketone

ElRo C¹³106

Ethyl phenyl malonate

EqL B-256

Ethyl phenyl propionate

EqL B-256

Ethyl propionate

EqL B-256

Ethyl radical

EqG S-134

Ethyl sorbate

EqL B-256

Ethyl stearate

EqL B-256

Ethyl toluate

EqL B-256

Ethyl trimethyl benzoate

EqL B-256

Ethyl valerate (iso)

EqL B-256

Ferric oxide

AdG B-235

Ferrous sulfide

EqH J-20

Fluorene

EqL B-257, K-37

Fluorenol

EqL B-257

Formaldehyde

EqL B-225, B-236, K-52

EqQ B-169, W-77

InKi W-7

Formaldehyde (Continued)

KiL	F-102
SpVi	E-1, H-82, R-28
ThF	T-46

Formate ion

EqL	S-95
InSt	S-95
KiH	F-98

Formic acid

Ed	K-16
EqI	O-36, S-49, S-51
EqL	B-236
SpVi	B-186, H-84, H-88, H-128, S-101
Sy	B-186, H-88

Formic acid, potassium salt of

EqL	S-96
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Formic acid, sodium salt of

EqL	S-96
EqQ	H-26, M-132
KiB	F-36
Sy	W-55

Fructose

EqL	H-29, K-80, O-5, O-6
KiL	K-80

Fumarase

KiB	P-36, P-39
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Fumaric acid

EcP	H-112
EqL	O-5
KiB	P-37, P-38, P-39
Sy	E-27
ThPh	E-27

Galactose

EqL	H-29, O-6
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Gallic acid, sodium salt of

EqQ	M-129
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Gelatin

KiB B-250
MeDf M-115
SpVi E-15

Glass

AdG D-33, I-52, I-53

Glucofructose

EqL H-29

Glucose

BiC R-40
ElRo H-30, H-31, P-2, P-4, R-43
EqL B-225, H-29, K-80, O-6
EqQ B-169
KiL B-169, B-216, F-103, H-30, H-31, H-33, K-80, M-90, M-92,
P-2, P-3, P-4, R-40, R-43, W-102
ThF M-90, M-92

Glucosides

KiB B-180, S-5

Glutaconic acid

EqL E-77

Glutamic acid

EqH R-83
EqL O-6, R-23

Glutaric acid

EqL O-5

Glycerol

EqL K-80, O-6
ElRo E-31
KiL K-80
Sy E-31

Glycine

EqI S-49, S-51
EqL B-236, B-237, O-3, S-92, S-93
EqQ G-74, H-26

Glycolate ion

KiL R-42

Glycolic acid

KiL F-102

Glyoxal

KiL F-102

Sy E-27

ThPh E-27

Glyoxal phenylhydrazone

Sy E-27

ThPh E-27

Gold

EcO H-141

KiH H-119

Gold hydride

SpEl H-74, H-75, I-3, I-4

SpVi O-41

Hemocyanin

KiL S-168

MeDf S-168

Heptane

EqL I-14

Hexane

ElCl K-88(s), K-89(s)

EqH F-27

EqL I-14

KiH F-27

Histidine

EqL S-143

Histidine hydrochloride

EqQ H-26

Homocystine

Sy P-31

Hydrazine

KiP C-127

Hydrazine sulfate

EqL B-236, B-237, S-92, S-93

Hydrides

EqH H-5

SpEl G-15, G-16, H-164, H-165, P-33

Sy H-5

Hydriodic acid

EcC A-5

EqG M-136, U-28

EqH R-89, R-90

KiG B-146, G-7

KiL C-32, C-37

KiP C-103

SpVi B-80

Sy R-90

ThF B-85, B-146, M-136, U-28

ThPh B-80, C-66, K-87, S-154

Hydrobromic acid

ElSc L-33

EqG M-136, W-67, W-68

SpVi B-81

Sy J-36, W-59

ThF B-85, M-136

ThPh B-81, C-66, K-87, S-154

Hydrocarbons

An M-96

KiH F-11, F-42

Hydrochloric acid

EcC B-13, F-67, I-7, L-56, L-88, T-89

EcO H-114

EcP L-5, N-26, R-116

ElD B-102

ElRf F-115, T-88

ElSc L-33

EqG B-225, C-126, G-64, M-136, S-139, U-28, W-67, W-68

EqH K-14, K-91, P-9, P-10

Hydrochloric acid (Continued)

EqL	I-13, K-44, K-60, K-91, L-5, L-12, L-66, R-116, W-71
InKi	H-152, N-16
KiG	B-84, G-7, G-64, S-139
KiL	B-220, G-4, K-4, O-36
KiP	L-42
MeD	T-88, T-89
SpEl	C-52, N-29, N-30
SpVi	H-54, W-45, W-46
Sy	B-102, L-27, S-139, T-88
ThF	B-84, K-44, K-91, M-136, N-26, R-116, U-28
ThPh	C-26, C-66, K-87, L-64, S-154
ThSo	B-220

Hydrocinnamic acid

ElRo	E-42
Sy	E-41

Hydrocyanic acid

SpVi	A-13, B-77, B-78, C-110, H-70
ThPh	C-26, C-66, L-67

Hydrofluoric acid

KiG	L-86
ThPh	C-26, C-53, C-66, F-110

Hydrogen

AdG	B-64, B-67, B-91, B-92, B-93, B-157, B-190, B-271, B-272, D-32, D-33, E-11, G-28, H-156, I-1, I-36, K-5, K-54, K-55, K-56, K-62, K-68, L-48, M-16, M-20, M-21, M-42, M-60, M-61, M-105, P-1, P-58, S-97, S-112, S-158, S-159, T-20, T-44, U-2, W-39
Cr	T-69
EcC	B-108, L-56, S-77, S-79, U-2
EcO	C-6, C-8, H-110, H-111, H-112, H-113, H-141, H-144, N-33, V-1
EcP	A-4, A-8, H-24, H-27, H-112, H-136, N-26, S-50, S-51, U-28
El	B-225
ElD	B-100, B-249, I-49, K-24, K-25, K-26, M-48
ElGd	G-70, G-79, G-80, G-81, J-25, J-26, L-39, P-26, R-65, S-138
ElMg	R-5, R-6, S-79, W-79, W-80
ElRf	F-111, O-32, O-33

Hydrogen (Continued)

ElSc	L-31, L-32
EqG	A-8, A-48, B-225, B-271, B-272, C-67, C-122, C-126, F-7, F-19, G-12, G-51, G-53, G-64, H-22, I-29, J-24, J-32, J-48, M-136, P-12, R-81, R-90, S-136, S-139, T-27, T-70, T-80, U-3, U-28, W-65, W-66, W-67, W-68
EqH	A-8, B-145, B-169, B-199, B-225, B-276, C-26, C-27, C-119, C-120, C-121, C-122, F-6, F-12, F-13, F-16, F-17, F-18, F-27, F-40, F-47, F-76, G-11, G-50, H-138, H-139, H-146, I-29, J-32, K-14, K-55, K-91, O-7, O-14, O-23, L-71, M-105, P-9, P-10, R-89, R-90, S-74, T-19, T-20, T-26, T-28, T-70, T-73, T-100, U-3, W-37, W-38
EqI	H-27, S-50
EqL	C-20
EqQ	B-179, F-34, H-18, H-22, H-138, M-99, R-91
Ki	P-56
KiG	A-22, B-1, B-84, B-98, B-169, B-173, B-273, C-82, D-4, E-79, F-7, F-8, F-19, F-20, F-31, F-32, F-33, F-39, F-41, F-43, F-48, F-120, G-7, G-12, G-46, G-64, H-116, H-118, H-121, J-32, K-18, K-41, L-48, M-51, M-52, M-84, M-95, M-100, P-32, P-41, P-55, R-103, S-104, S-130, S-131, S-136, S-139, S-157, T-80
KiH	A-34, B-86, B-191, C-6, C-7, C-8, E-11, E-12, E-58, F-4, F-11, F-9, F-21, F-22, F-24, F-26, F-27, F-28, F-29, F-42, F-45, F-46, G-10, G-11, G-12, H-117, H-118, H-119, H-143, I-31, J-32, J-36, J-37, K-53, K-55, K-56, M-53, M-83, M-101, M-102, M-103, M-105, O-14, P-58, S-97, T-20, T-96, T-97, T-98, T-100, T-102, U-8, W-40
KiI	O-16
KiL	A-2
KiP	F-37, J-45, L-42, M-51, M-53, M-58, M-97, M-98, M-104, S-100, S-136
KiR	L-77, M-134
Me	B-225
MeAc	E-72, I-37, I-42, I-43, I-50, I-51, I-54, R-63
MeD	B-69, C-66, C-105, M-45, M-46, M-68, S-23, S-24, S-25, T-69, U-1
MeDf	C-118, D-35, E-72, F-13, F-68, F-69, F-100, F-101, G-76, G-77, G-81, H-70, I-41, J-37, J-38, J-39, L-84, M-38, M-61, S-164
MeSt	D-32, H-53, I-34
MeV	A-21, A-23, B-12, B-234, H-25, I-38, I-39, I-44, I-45, I-46, I-47, I-48, T-75, V-2, V-4, W-40
So	B-225

Hydrogen (Continued)

SoG	S-77, S-78, S-80, S-81, S-82, S-83
Sp	S-119, U-21
SpEl	B-125, B-127, B-128, B-129, C-52, D-25, D-26, D-27, D-28, D-30, D-31, E-22, F-84, F-85, F-86, F-87, F-120, F-125, G-161, H-69, J-6, J-9, J-10, K-32, M-47, O-25, S-19, T-77, W-29, W-92, W-95
SpVi	A-36, A-62, B-131, B-132, B-133, E-22, E-70, E-78, H-162, M-70, S-7, S-8, T-34, V-5, W-43
SpX	F-118
Sy	B-126, F-47, H-118, K-63, N-28
Th	B-225
ThD	A-23, A-56, A-57, B-166, B-167, F-105, K-11, K-12, K-50, N-32, S-28
ThF	B-75, B-84, B-85, B-101, B-138, B-159, C-66, C-67, C-68, C-70, C-71, C-72, C-73, C-75, C-76, C-77, C-78, C-88, C-98, E-70, F-71, H-123, I-49, I-51, I-54, J-24, J-48, K-91, L-45, M-58, M-69, M-118, M-136, N-26, S-26, S-54, S-157, T-69, T-80, U-21, U-28, V-3, W-37
ThPh	B-69, B-226, B-227, B-228, B-229, C-26, C-64, C-65, C-69, C-70, C-73, C-74, C-77, C-97, C-98, E-70, L-57, L-58, L-59, L-72, M-4, M-49, S-26, S-27, S-53, S-54, S-55, S-140

Hydrogen halides

KiH	E-76
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Hydrogen ion

EcC	B-109, C-10, W-14
EcP	A-4
EQI	A-3, A-4, D-53, E-28, G-35, G-63, H-27, K-44, K-91, M-80, S-49, S-50, T-74, W-105
EqL	A-8
KiI	B-172, B-178, H-150, M-90
MeDf	W-82
SpVi	L-18
ThF	K-91, O-36

Hydrogen peroxide

EqL	A-9, A-10, E-36, F-50
EqQ	W-77
KiH	G-24, O-24
KiL	C-32, C-37

Hydrogen peroxide (Continued)

MeD	F-52
SpVi	F-50, F-51
Sy	F-50, F-52
ThF	G-24

Hydrogen selenide

CrX	V-8, V-10
ElRf	F-116
ElSc	L-32
MeD	K-105
SpVi	C-9
Sy	K-104
ThPh	C-66, K-87, K-102, K-104, K-105

Hydrogen sulfide

CrX	V-8, V-10
ElRf	F-111
ElSc	L-33
EqG	G-53, J-32
EqH	G-53, S-94
EqL	G-8, T-9
InKi	T-9
KiG	J-32
MeD	K-105
SpVi	B-5, B-6, M-140, M-141, N-14, N-15
Sy	K-104, N-14
ThPh	C-66, K-87, K-103, K-104, K-105

Hydroquinone

EqI	R-116, S-49
EqL	B-236, B-237, B-244, R-116
EqQ	H-26, M-130
SoH	K-91
ThF	K-91, R-116

Hydroxybenzaldehyde

SpVi	M-27
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Hydroxyl

SpEl	C-22, C-23, I-21, I-22, I-23, I-24, I-25, I-26, J-15, J-21, J-22, N-6, O-40, R-19, R-20, R-21, S-9, S-10, S-11, S-12, S-13, S-14, S-15, S-16, S-65
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Hydroxyl (Continued)

SpVi B-275, C-51, E-66, O-40, P-72

Hydroxylamine

EqL O-5

Hydroxylamine hydrochloride

EqL O-3

Hydroxyl ammonium chloride

Sy R-29

Hydroxyl ammonium ion

SpVi R-29

Hydroxyl ion

EcC B-109, W-14

EcP A-4

EqI A-3, A-4, D-53, E-28, K-44, K-91, O-7, T-74, W-105

EqL A-8

KiL O-34

KiL A-2, M-33, R-42

ThF K-91

Hypophosphites

KiH F-98

Hypophosphorous acid

EqI E-59

Indene

ElD C-18

EqL K-71

SpVi M-28

Indole

EqL K-71, K-78

KiL K-78

Inulin

EqL O-6

Iodate

KiL A-6

Iodide

EqL	A-7, A-9, A-10
KiL	A-6

Iodine

EqG	A-48
EqH	R-89, R-90
KiG	G-7
KiH	G-10
SoH	A-7
ThPh	C-33

Iron

AdG	B-157, K-55, K-56
EqH	J-20, T-26
KiH	H-119, K-53, K-55, K-56
MeDf	G-77, G-81
SoG	S-83

Ketoglutaric acid

EqH	R-83
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Krypton hydrate

ThPh	G-34
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Lactose

EqL	O-6
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Lauric acid

Sy	H-109
ThPh	H-109

Lead

EcO	H-141
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Lead sulfate

EqL	S-67
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Leucine

EqL	S-44
InBi	R-24

Lithium

EqH	J-20, W-37
ThF	W-37

Lithium bromide

ThSo B-143

Lithium chloride

EcC C-47

MeV C-47

SoH L-18

ThSo B-143, L-21

Lithium fluoride

SoH L-18

Lithium hydride

CrX T-90, Z-9

ElCl K-15

EqH T-90, W-37, W-38

MeD T-90, W-37

SpEl C-52, C-111, C-112, C-113, C-114, C-115, C-116

ThF K-15, W-37

ThPh T-90

Lysine

EqL S-143

Sy W-33

Magnesia

AdG I-30

Magnesium

EqH J-20

MeDf M-38

Magnesium hydride

SpEl F-122

SpVi G-82

Magnesium sulfate

ThPh B-95

Maleic acid

EcP H-112

EqH R-83

EqL O-5

EqQ M-132

Malic acid

EqL O-5

KiB P-37, P-38, P-39

Malico dehydrogenase

BiC J-2

Malonic acid

EqQ H-26, M-132

SpVi E-4

Sy B-200, E-61, H-13, W-55

ThPh H-13

Maltose

EqL O-6

Mandelic acid

ElRo E-50

Sy E-50

Manganese

EqH J-20

Manganese chloride

ThPh M-126

Manganese sulfate

SoH E-2

Mannite

SoH N-1

Mannitol

EqL H-29

Mannose

EqL H-29, K-80

Menthol

ElRo O-8

Mercuric chloride

EcC I-10

Mercuric chloride (Continued)

EqL I-10
SoH E-3

Mercuric cyanide

ThSo L-18, L-21

Mercury

EcO H-110, H-111, H-113, H-114, H-141, N-33
EqG T-27
KiH H-119
KiP J-43, J-45, J-46, M-54, M-58, M-59, M-97, M-98, S-134

Mercury dimethyl

KiP S-100

Mercury hydride

SpEl F-124, G-61, O-25
SpVi H-134, M-120, M-121, M-122, M-123, M-124

Mesocystine

EqL S-143

Methane

AdG B-64
EqG C-102
ElRf F-112
ElSc L-32
EqG G-12, S-136, T-27, T-80
EqH H-12
EqQ M-99
KiG G-7, G-12, G-46, M-95, M-100, S-130, S-136, T-80
KiH M-101, M-102
KiL C-90
KiP F-37, M-97, M-98, M-104, S-136
MeD K-105
MeDf I-41
MeV B-221, I-35
SpEl N-17
SpVi B-39, B-107, C-42, C-43, D-2, D-21, G-29, M-14, M-15, M-95, R-28, W-60
Sy B-200, C-43, F-112, M-15, M-95, S-137, U-27, W-31
ThF B-74, C-66, C-88, C-91, F-96, T-80
ThPh C-66, C-87, C-88, C-91, F-96, F-97, K-105, S-137

Methionine

InBi S-86
Sy P-31

Methoxybenzalbenzylamine

KiL S-4

Methoxyfluorene

EqL B-257

Methoxynaphthalene

EqL K-37

Methyl acetate

EqL B-219
KiL B-216, B-219, H-151, N-8, R-43

Methylacetylacetone

EqL N-1
KiL N-1

Methylacridane

EqL B-258

Methyl alcohol

ElRo O-8
EqI G-41
EqL G-8, H-17, N-1, O-12, O-13, O-17
KiL G-4
MeD R-48
SpVi B-38, B-76, B-79, G-39, G-41, M-87, N-23, P-72, R-31, R-32
Sy N-23, O-12, R-32
ThF H-17

Methylamine

EqL G-36
EqQ R-91
SpEl F-77, F-78
SpVi E-5, E-18
Sy E-18, F-78
ThPh E-18

Methylbenzylamine

ElRo Y-6

Methyl bromide

SpVi N-22

Sy N-22

Methylcarbazole

EqL B-258

Methyl chloride

EqQ H-49

SpVi N-16, N-22

Sy N-22

Methylcyclohexane

EqL I-14

Methyldiphenylamine

EqL B-258

Methyl ether

InKi S-133

Methyl ethyl ketone

InKi A-34

Methyl galactoside

EqL H-25

Methyl glucoside

EqL H-29

Methylindole

EqL K-70, K-75

KiL K-75

Methyl mannoside

EqL H-29

Methyl oleate

KiH B-86

Methyl radical

EqG S-134

Methyl tartrate

ElRo B-266

Molybdenum dioxide

AdG H-157

EqH T-70

Naphthalene

Sy C-57

Neodymium oxalate

KiH F-46

Neodymium sulfate

ElCl F-59, K-1

Nickel

AdG I-1, I-36, K-54, K-55, L-48, M-16, M-105

EcO H-141

KiH F-4, F-29, H-119, T-98, T-102

MeDf G-77

SoG S-80

Nickel chloride

KiH F-46

ThPh B-95

Nickel sulfate

ElCl Z-3

ThPh B-96

Nicotine

SoH B-266

ThPh H-21

Nitramide

EqL L-11

KiH G-58

KiL L-10, L-81

Nitric acid

EcC I-7, T-89

Nitric acid (Continued)

ElRf	R-30, T-88
MeD	R-30, T-88, T-89
SpVi	B-17, R-30
Sy	B-17, T-88

Nitric oxide

KiG	F-43, H-116
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Nitrobenzene

SoH	V-14
Sy	C-55

Nitrodimethylaminonaphthalene

EqL	B-258
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Nitrodimethylaniline

EqL	B-257
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Nitroethane

ElCl	M-32
EqL	M-35
KiL	M-34, M-35
ThF	M-35

Nitrogen hydride

SpEl	D-29
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Nitroisopropane

KiL	M-35
ThF	M-35

Nitromethane

EqL	I-19, R-41
KiL	R-41, W-102
SpVi	W-63
Sy	R-41, W-63

Nitroparaffins

KiL	M-33
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Nitrophenol

EqL	K-79, K-81, K-83, M-37
KiL	K-79, K-83

Nitrotoluene

EqL K-37

Nitrous oxide

KiG M-51

KiP M-51, M-53

Octanol

ElRo Y-5

Sy Y-5

Olefins

EqH T-100

KiH T-100

Orcin

EqQ M-130

Ornithine

InBi C-92

Sy C-92

Oxalic acid

Cr R-93, R-94

EqI S-49

EqL O-5

KiL L-98, S-45

MeD R-95

Sy R-94, S-45

ThPh B-96, R-93

Oxalic acid, sodium salt of

EqL O-5

Oxygen

AdG K-5

EqH G-1

EqQ H-22

KiG C-82, F-41, F-120, H-118, K-18, K-41, M-51, P-32, S-157

KiH H-117, H-118, T-96, T-97

KiP M-53

KiR L-77

ThF F-71

Palladium

AdG	G-28, M-61, S-159, U-2
Cr	U-2
EcC	S-77, S-79, U-2
ElMg	S-79
EqH	R-83
KiH	F-29, J-37, T-96, T-97
MeDf	F-13, F-100, F-101, G-77, H-61, J-37, J-38, L-84
SoG	S-77, S-78, S-82

Palladous tetrammine

KiL	A-29
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Palmitic acid

EqL	R-87, S-44
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Paraldehyde

SpVi	W-94
Sy	H-109
ThPh	H-109

Penicillin

EqQ	O-2
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Pentaerythritol

CrX	U-5
Sy	U-5

Pentane

ElRf	W-42
InKi	H-152, H-153
SpVi	R-11, R-12, W-42
Sy	W-42
ThPh	W-42

Perbromate

EqL	A-7
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Perchlorate

EqL	A-7
-----	-----

Perchloric acid

EcC	F-67
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Perchloric acid (Continued)

EqL O-5
SpVi F-80
Sy F-80

Phenol

EqL B-236, H-49, H-51, I-13, I-19, K-69, K-82, S-96
KiL K-69, K-82
MeD P-29
SoH N-1, P-53, T-56
SpVi W-54
Sy B-122, K-49, W-54
ThPh H-21

Phenylaminobutyric acid

KiB V-18

Phenylbenzaldehyde

EqL T-45
Sy T-45

Phenyl butyl ketone

KiL H-156

Phenyl carbazole

EqL B-258

Phenyldimethylmethane

SpVi B-259
Sy B-259

Phenyltolyl

Sy I-60

Phenyltolylacetic acid

ElRo I-60
KiL I-60

Phloroglucinol

EqQ M-129

Phosphatase

KiB P-36

Phosphine

KiG	G-7
KiP	M-58, M-59
SpVi	H-79, H-80, L-38, S-166
Sy	H-79, H-80, L-38
ThF	B-66, M-58
ThPh	C-66, K-87

Phosphonium iodide

Sy	H-80
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Phosphoric acid

EqI	R-116, S-49, S-51
EqL	O-5
KiL	F-30
SpVi	S-87, W-45, W-46
Sy	F-30, S-87

Phosphorus

KiG	K-41
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Phosphorus hydride

SpEl	I-27, I-28, P-34
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Phthalic acid

Cr	R-94
MeD	R-95
Sy	R-94

Picoline

SoH	P-59, T-57
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Picric acid

EqI	S-49
ThPh	G-69

Platinous tetrammine

KiL	A-29
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Platinum

AdG	K-5, M-20, M-21, M-42, T-44
EcO	H-141
EcP	H-136
EqH	F-18, H-139, R-83

Platinum (Continued)

InKi	H-136
KiH	E-12, F-9, F-21, F-22, F-26, F-28, F-29, H-119, H-143 M-53, M-83, O-24
MeDf	D-35, G-77, J-39

Potassium

EqH	J-20
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Potassium bromate

EcC	R-107
ThSo	L-21

Potassium bromide

EqL	K-44
SoH	E-3
ThF	K-44
ThSo	L-21, L-22

Potassium carbonate

SpVi	P-53
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Potassium chlorate

EcC	R-107
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Potassium chloride

EcC	B-13, F-113, I-7, L-8, L-14, L-56, L-88, R-104, R-105, T-89
ElD	D-36
EqL	M-78
MeD	R-104, T-89
MeV	R-104, R-105
SoH	L-18, M-78, S-66
ThF	L-15
ThPh	N-20, N-21, R-98
ThSo	L-21, L-22, R-98

Potassium cyanide

ThSo	L-21
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Potassium fluoride

ThPh	B-96
ThSo	L-21

Potassium fluoride, acid

CrX	U-5
SpVi	K-35, K-36
Sy	U-5

Potassium hydride

SpEl	I-5
Sy	H-4, S-113
ThD	S-113
ThPh	S-113

Potassium hydroxide

EqL	K-44
ThF	K-44

Potassium hypophosphite

EqL	B-199
EqQ	H-18

Potassium iodate

EcC	R-107
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Potassium iodide

SoH	E-3
SpEl	D-49
ThSo	L-21, L-22

Potassium ion

EcC	L-56
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Potassium nitrate

EcC	I-7
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Potassium permanganate

KiL	C-32
-----	------

Potassium phosphate, dihydrogen

CrX	U-4, U-5, U-6, U-7
ElD	B-19, Q-1, Z-19
EqI	E-35
EqL	B-225
Sy	B-19, U-5, U-6
ThF	B-19

Potassium phosphate, hydrogen

EcP R-116

EqL H-28

SpVi S-87

Sy S-87

Potassium sulfate

EcC I-7

EqL S-67, H-28

SpVi H-78

Praseodymium sulfate

ElCl K-1

Propane

EqG T-80

EqH F-12, M-105

EqQ M-99

InKi S-135

KiG M-95, M-100, T-80

KiH M-105

Sy M-105

ThF T-80

Propionic acid

InKi H-127

SpVi H-87

Sy H-127

Propyl alcohol

KiH A-34, F-26

Propylene

EqH M-105

KiG M-95

KiH M-105

KiL F-30

Protein

SpVi E-15

Pyrogallol

EqL B-236

Pyrogallol (Continued)

EqQ M-129
KiL G-6

Pyrrole

ElD C-19
EqL H-49, H-51, I-19, K-76
SpEl M-74
SpVi B-182, M-79, R-34
Sy M-79, R-34

Pyruvic acid

EqL G-9

Quartz

EqH F-18

Quinaldine

EqL B-257, K-37

Quinhydrone

EcP H-27, K-91, L-5, L-12, R-116
EqI H-27, L-12, L-13
EqL K-91, L-5, L-12

Quinoline

KiH C-7

Quinone

KiH C-7
SoH K-91, L-18

Resorcinol

Cr R-94
EqL H-28
EqQ M-130
KiL G-6
MeD R-95
Sy R-94

Rubidium bromide

ThSo L-21

Rubidium hydride

Sy H-4
ThPh B-188

Salicin

KiB S-129

Salicylaldehyde

SpVi B-183, B-184
Sy B-183, B-184

Salicylic acid

EqI K-91, S-49
KiL B-215

Salicylic acid, sodium salt of

EcP K-91

Silane

ThPh S-153, S-154

Silica gel

AdG K-39

Silicobromoform

SpVi D-16

Silicochloroform

SpVi D-16

Silicoethane

ThPh S-153, S-154

Silicon dioxide

AdG B-235

Silicon hydride

SpEl R-100
SpVi R-100

Silver

EcO H-141

Silver (Continued)

KiH H-119

MeDf G-77

Silver chloride

KiH I-31

Silver hydride

SpEl K-84

Silver nitrate

ThSo L-21

Silver permanganate

SoH H-76, L-18

Sodium

EqH J-20

KiH E-76, G-7

Sodium bromide

SoH E-3

ThPh E-3, B-95

Sodium carbonate

SpVi P-53

Sodium carbonate, acid

Cr R-94

MeD R-95

Sy R-94

Sodium chloride

EcC C-47, F-113, L-88, T-89

KiL B-220

MeD T-89

MeV C-47

SoH A-48, C-10, C-32, C-36, E-3, L-18, T-18

SpEl D-50

ThF G-35

ThPh C-10, R-98

ThSo B-220, L-20, L-21, L-22, R-98

Sodium chromate

ThPh M-126

Sodium hydride

SpEl O-26, O-27, O-28

Sy H-4, S-114

ThF S-114

ThPh S-114

Sodium hydroxide

EcC R-106

EqH J-20, K-91

EqL B-236, B-237, H-28, O-5, S-67

KiL H-156, W-9

SpVi P-53

Sy B-222, H-80

ThF K-91

Sodium hypophosphite

Sy F-98

Sodium iodide

SoH E-3

ThPh E-3

Sodium nitrate

ThSo L-21

Sodium perchlorate

ThSo L-21

Sodium phosphate, dihydrogen

EcP R-116

Sodium selenate

ThPh M-126

Sodium sulfate

EqL S-67

MeDf O-35

SoH E-3

ThPh B-95, E-3, E-35, E-36, H-115, T-15

Sodium sulfate, acid

CrX U-5

Sy U-5

Sodium thiosulfate

ThPh M-126

Stannic oxide

EqH I-29

Starch

BiC F-93

EqL O-6

KiB C-3

Stearic acid

SpVi C-93

Sy S-36

Strontium chloride

CrX U-5

EqL M-78

SoH M-76

Sy A-27, U-5

ThPh B-95, M-76, M-78

Strontium hydride

SpEl W-30

Styrene

EqL B-257

InKi Y-3

KiL K-77, T-68

Suberic acid

BiC B-116

InBi B-116

Sy B-116

ThPh B-116

Succinic acid

BiC B-116

Succinic acid (Continued)

Cr	R-94
CrX	U-5
ElRo	L-40
EqH	R-83
EqL	B-236, B-237, B-244, H-28, O-5
EqQ	H-26, M-132
InBi	B-116
KiB	E-60
MeD	M-13, R-95
Sy	B-116, H-13, L-40, M-13, R-94, U-5
ThPh	B-116, H-13, M-13

Succinic acid, sodium salt of

EqI	E-59
EqL	O-5

Succinic anhydride

MeD	M-13
Sy	M-13
ThPh	M-13

Succinimide

EqL	K-37
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Sucrose

BiC	R-40
ElRo	G-67
EqL	G-67, K-80, O-3
EqQ	B-169, B-174
KiB	S-128
KiL	B-169, G-67, G-68, H-32, H-33, H-50, M-90, M-91, R-40
ThF	M-90

Sulfuric acid

EcC	I-7
EqH	J-20
EqL	B-236, B-237, I-13, I-14, O-5, S-44, S-67
KiH	J-20
MeDf	O-35
SpVi	L-37, W-45, W-46
Sy	F-52, L-37, M-33

Tartaric acid

ElRo	O-8
Sy	E-27, H-2
ThPh	E-27

Tartaric acid esters

Sy	E-27
ThPh	E-27

Tartaric acid, potassium sodium salt of

ElD	H-2, H-129, H-130
ElMg	H-2
MeD	H-130

Tartaric acid, sodium ammonium salt of

ElRo	E-26
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Tetrachloroethane

Me	B-223
SpVi	T-92, T-93
Sy	B-223, T-93
ThPh	B-223

Tetramethylglucose

EqL	H-29
KiL	H-33

Tetrasilane

ThPh	S-154, S-155
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Thiazole

InSt	E-64
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Thiophene

ElRf	S-142
MeD	S-142
Sy	S-142
ThPh	S-142

Tin

EcO	H-141
EqH	I-29

Toluidine

EqH K-90

Toluidine hydrochloride

EqL O-22

InKi O-22

Trichlorophenol

EqL S-96

Triethylamine

SoH P-59, T-56

Trifluoroacetic acid

Ed K-16

Trihydroxybenzene

EqQ M-129

Trihydroxybenzoic acid, sodium salt of

EqQ M-129

Trimethylamine

EqI S-49, S-51

Trimethylamine hydrochloride

EqQ R-91

Trinitrobenzene

EqL K-37

Triphenylamine

EqL B-258

Triphenylmethane

EqL B-257, K-37

SpVi B-259

Sy B-259, H-13

ThPh H-13

Trisilane

ThPh S-154, S-155

Tritium

EqH B-145

Tungsten

AdG B-190, E-11

KiH E-11, E-13, J-44

Tyrosine

EqL S-143

Urea

CrX U-4, U-5

EqL B-236, B-237, H-28, O-3, O-5, S-92, S-93

EqQ H-26

KiB B-210, B-211

KiL O-6

SpVi O-41

Sy U-5

Vinylacetic acid

EqL I-56, I-58, I-59

InKi I-56

KiL I-56

Vitamin B₁

EqQ H-26

Water

AdG A-58, B-235, I-30, I-52, I-53, K-39, K-40

AdL K-43

CrX M-44, S-147, V-9

EcC B-109, F-90

EcO B-194, H-111, H-112, H-126

EcP B-230, B-231, B-232, F-81, M-128

El A-48, B-225

ElCl B-94

ElD A-1, B-142, D-36, D-37, G-71, L-65, M-127, T-1, T-50, W-101

ElGd T-103

ElMg C-1, C-2, F-117, G-54, H-122, I-32, N-7, O-20, S-59, S-120, T-81, T-82

ElMr D-60, G-2, H-6, O-19, S-89

ElRf B-87, B-88, C-13, C-26, C-133, C-134, L-60, L-103, M-39, O-19, S-59, S-152, T-29, T-52, W-21

Water (Continued)

ElRo	O-20
ElSc	B-130, B-135, C-12, L-32
EqH	A-8, B-65, B-145, F-17, H-140, I-2
EqI	A-4, D-53, E-28, K-44, T-74, W-105
EqL	A-3, A-8, B-104, F-50, O-36, R-17, R-55, T-73
KiB	A-35, B-54, B-56, B-250, C-3
KiG	D-4, E-79
KiH	S-127
KiL	B-178, H-15, W-73
KiP	M-56, P-67
Me	A-46, A-48, B-140, B-225
MeAc	B-2, I-37, I-40, Y-2
MeD	B-68, B-134, B-135, C-26, C-32, C-34, C-35, C-48, C-81, C-134, H-151, I-6, I-59, J-19, J-28, K-3, L-62, L-78, L-87, L-94, L-103, M-75, M-117, R-115, S-32, S-59, S-120, S-156, S-170, S-171, T-2, T-12, T-29, T-55, T-87, W-21, W-74, W-75, W-101, Y-2
MeDf	I-41, M-115, O-35, O-37, T-40
MeSt	B-105, C-94, F-72, I-6, J-28, L-1, L-2, S-59, T-1, T-4, T-53, T-86
MeV	B-13, C-10, J-27, L-44, L-63, L-94, S-59, T-29
So	B-225, T-1
SpEl	F-101, O-1, S-32
SpVi	A-12, A-24, A-25, A-26, B-41, B-71, B-72, B-82, B-185, C-11, C-12, C-13, C-15, C-29, C-125, E-17, E-66, E-78, F-40, F-127, G-40, G-42, G-43, G-44, G-45, H-98, H-99, K-22, K-42, L-71, N-31, P-53, R-13, R-14, R-15, R-16, R-17, R-18, R-22, S-69, S-91, S-111, V-6, W-46, W-83, W-84, W-85, W-86, W-87, W-88, W-89
SpX	M-43
Th	B-140, B-225
ThD	B-233, L-17, M-67
ThF	B-110, B-143, C-95, D-38, F-56, F-71, H-15, J-48, K-44, L-15, L-85, R-112, W-36, W-103
ThPh	B-73, B-233, B-253, B-254, C-26, C-66, D-13, D-22, D-38, E-73, E-74, H-115, J-1, L-6, L-9, L-18, L-47, L-55, L-62, L-85, M-75, R-14, R-38, R-69, R-70, R-74, R-75, R-112, S-99, S-127, S-137, S-152, T-5, T-6, T-7, T-29, T-51, T-54, T-55, T-58, T-73, U-17, W-3, W-21
ThSo	B-104, B-143, B-144, C-44, D-38, D-39, L-18, L-73, M-48

Xenon hydrate

ThPh G-34

Xylenol**Sy K-49****Zinc****EqH J-20****Zinc hydride****SpEl F-123****Zinc oxide****AdG S-97****KiH S-97****Zinc sulfate****ThPh B-96**

